

# HEALTH CONSULTATION

MOBERLY FORMER MANUFACTURED GAS PLANT  
MOBERLY, RANDOLPH COUNTY, MISSOURI  
[EPA FACILITY ID: MOD985796135](#)

*May 8, 2002*

Prepared by:

Missouri Department of Health and Senior Services  
Section for Environmental Public Health  
Under a Cooperative Agreement with the  
Agency for Toxic Substances and Disease Registry

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# HEALTH CONSULTATION

## MOBERLY FORMER MANUFACTURED GAS PLANT MOBERLY, RANDOLPH COUNTY, MISSOURI

### STATEMENT OF ISSUES AND BACKGROUND

#### Statement of Issues

The Missouri Department of Health and Senior Services (DHSS), in cooperation with the federal Agency for Toxic Substances and Disease Registry (ATSDR), completed this [health consultation](#) at the request of the Missouri Department of Natural Resources (MDNR). Its purpose is to determine whether residents living next to, and workers at, the Moberly Former Manufacturing Gas Plant (FMGP) are being exposed to hazardous substances at levels that could result in adverse health effects.

#### Background

The Moberly Former Manufactured Gas Plant (FMGP; sometimes referred to as "the site") comprises approximately 1 acre, and is located within the 3-acre area of the active Ameren-UE Service Center at 509 Dameron Street in downtown Moberly, Missouri (See [Figure 1](#)). The site is in a light commercial/residential area and is bordered on the north by Sturgeon Street and the Norfolk Southern railroad yard. To the east the site borders Dameron Street and a long-abandoned poultry plant, and to its south is Franklin Street and a residential area, with the rest of the Ameren-UE Service Center to the west (1).

In the neighborhood south and east of the site are an estimated 20 residences, all within 1 block of the site. According to the 1990 U.S. Census, approximately 373 people live within ¼ mile of the site. The school nearest the site on the topographic map in [Figure 1](#) is no longer utilized. There are 27 employees of Ameren-UE who report to the Service Center, but are gone from the site most of the day. One clerical employee does work in the Ameren-UE Service Center main office full time, but is not expected to be exposed to the contaminated FMGP area (1).

Residents in the area of the FMGP site are on the Moberly public water system—a system that obtains its drinking water from surface sources not expected to be affected by the site. Surface water drainage from the site is diverted into a storm sewer drain that ultimately flows to the Moberly Water Treatment Plant (1).

The Moberly FMGP is believed to have been in operation as early as 1875 and continued in operation until 1935. The FMGP has had numerous owners throughout the years and is presently owned by Ameren-UE. The FMGP operation consisted of both above- and below-ground structures with some gas plant structures still remaining. In the past the main manufactured gas plant building had been used for storage, but that was halted because the building was considered structurally unsafe (1). That building has since been demolished because of its unsafe condition and in preparation for cleanup (Personal communications between Missouri DHSS personnel, MDNR personnel, and Ameren-UE personnel during site visit, 2001 October 4).

In 1991, a Preliminary Assessment (PA) of the site was performed for the Environmental Protection Agency (EPA). That PA determined gas production at the Moberly FMGP had ranged from a minimum yearly production of 6.5 million cubic feet to a maximum of 61 million cubic feet. It also reported that an estimated 120,000 gallons of coal tar was generated. Coal tar is the waste product of the destructive distillation of bituminous coal to produce a flammable gas (1). It is not expected that this amount of coal tar remains on site because of FMGP practices of selling—or using—the coal tar for fuel. The PA determined that there was the potential for coal tar contamination of the site's surface soils, subsurface soils, and groundwater because of spillage and general FMGP practices of burying tar and purifier wastes on site.

To determine the actual contamination at the Moberly FMGP, an Integrated Site Inspection/Removal Site Evaluation (SI/RSE) was conducted by MDNR in February 2000, in cooperation with the Ameren-UE contractor. MDNR collected 16 samples of soil at varying depths from 13 of the 28 probe holes the contractor placed throughout the site. In addition, MDNR collected a shallow soil sample (3-4 inches) off site in a residential yard. Groundwater samples were also taken from four monitoring wells on site and analyzed for polycyclic aromatic hydrocarbons (PAHs) and heavy metals (1).

During the February 2000 SI/RSE sampling, it was confirmed that some remaining underground structures still contained coal tar. They included the masonry tank of the relief gas holder, a rectangular tar well, and a circular tar tank. Soil in the vicinity of the below-grade tar handling structures is expected to have been impacted by the coal tar to a depth of approximately 20 feet (1).

Because an FMGP [contaminant](#) was detected in the residential soil sample, MDNR conducted additional sampling of the residential area in July 2001. MDNR collected six surface soil grab samples (0-3 inches deep) from residences closest to the site where permission could be obtained. Soil samples were split with a representative from Ameren-UE (2).

On October 4, 2001, DHSS and MDNR personnel conducted a site visit and met with the Ameren-UE representative, who provided a tour and described remediation activities planned for the site ( Personal communications between Missouri DHSS personnel, MDNR personnel, and Ameren-UE personnel during site visit, 2001 October 4). It was confirmed that the main manufactured gas plant building had been demolished in preparation for site remediation. The surface of the site is fairly level and covered with approximately 4 to 6 inches of gravel in most areas. No coal tar odor was noticed during the site visit. Access to the Ameren-UE facility and the FMGP area is restricted by a 6-foot chainlink fence topped with barbed wire. An additional fence surrounds a coal tar well area to prevent worker access (Personal communications between Missouri DHSS personnel, MDNR personnel, and Ameren-UE personnel during site visit, 2001 October 4).

After the October 2001 on-site visit and meeting with the Ameren-UE representative, DHSS and MDNR personnel walked through the residential area, where the MDNR representative pointed out locations at which surface soil samples had been taken. At the residence nearest to the site and where the FMGP contaminant was detected, it was observed that a child or children had been playing with soil on the sidewalk near where the soil sample had been taken. This was the only location in the neighborhood where actual activity in the soil was observed; however, at least one other residence had indicators that children were present. Yards in the neighborhood had good groundcover and no gardens were noticed during the walk-through of the residential area nearest the site.

During that same site visit, the Ameren-UE representative indicated that Ameren-UE would be remediating the site in cooperation with MDNR. In a discussion of the process, the representative indicated that to avoid releases into the air Ameren-UE would be using a negative atmosphere tent enclosure (Personal communications between Missouri DHSS personnel, MDNR personnel, and Ameren-UE personnel during site visit, 2001 October 4). During later conversations with the MDNR representative, it was learned that Ameren-UE would be expected to clean up the site to at least industrial levels (or Scenario C in the Cleanup Levels for Missouri [CALM] document) (Telephone conversation with Missouri Department of Natural Resources site project officer, 2001 December 14). According to the CALM document, if using industrial standards benzo(a)pyrene would have to be cleaned to 0.6 ppm (3).

## **On-Site Contamination**

Contamination detected on site during the February 2000 SI/RSE in shallow and subsurface soils is listed in [Tables 1](#) and [2](#). The level of detected contaminants is compared to DHSS's Any-Use Soil Levels (ASLs) and ATSDR's Environmental Media Evaluation Guides (EMEGs) screening values. This is to determine if the chemical exceeds that value and should be further evaluated to assess possible health effects associated with

human [exposure](#). An evaluation of chemicals exceeding their screening values will follow in the Discussion Section. [Table 1](#) includes contaminants found in shallow soils on the Moberly FMGP site that were above their screening values.

**Table 1. Moberly FMGP On-Site Shallow (range 4 to 12 inches) Soil Contamination Detected (1) in February 2000 SI/RSE and ASL and EMEG Screening Values (in ppm)**

Chemical	Minumum	Maximum	ASL	EMEG
Benzo(a)pyrene	2.6	1,200	0.68	N/A
Benzo(a)anthracene	2.1	440	4.5	N/A
Benzo(b)fluoranthene	2.3	310	4.0	N/A
Benzo(k)fluoranthene	1.9	300	34	N/A
Chrysene	2.2	410	160	N/A
Dibenz(a,h)anthracene	0.84	95	0.62	N/A
Ideno(1,2,3-cd)pyrene	1.1	160	12	N/A
Naphthalene	0.68	1,100	230	1,000*
Pyrene	4.2	2,200	1,700	2,000*

ppm = parts per million

\* = value for child (non-pica) (pica is a abnormal appetite for non-food items; e.g., soil, dried paint)

ASL = MO. DHSS Any-Use Soil Level

EMEG = ATSDR's Environmental Media Evaluation Guide

N/A = Not Available

[Table 2](#) includes contaminants found above their screening values in subsurface soils on the Moberly FMGP site.

**Table 2. Moberly FMGP On-Site Subsurface (range 1 to 8 feet) Soil Contamination Detected (1) in February 2000 SI/RSE and ASL and EMEG Screening Values (in ppm)**

Chemical	Minumum	Maximum	ASL	EMEG
Benzo(a)pyrene	1.7	3,000	0.68	N/A
Benzo(a)anthracene	1.2	1,900	4.5	N/A
Benzo(b)fluoranthene	0.8	1,500	4.0	N/A
Benzo(k)fluoranthene	0.84	1,800	34	N/A
Chrysene	2.3	2,200	160	N/A
Dibenz(a,h)anthracene	3.6	240	0.62	N/A
Fluoranthene	2.8	3,500	2,300	20,000*
Fluorene	0.34	2,600	2,300	20,000
Ideno(1,2,3-cd)pyrene	0.46	360	12	N/A
Naphthalene	2.5	5,500	230	1,000*
Pyrene	4.2	4,600	1,700	2,000*
Benzene†	<0.006	610	170	N/A
Toluene†	<0.006	831	490	1,000*

Total Xylenes†	<0.017	519	480	10,000*
Arsenic†	12	45	11	20*

ppm = parts per million

\* = value for child (non-pica) (pica is a abnormal appetite for non-food items; e.g., soil, dried paint)

† = Results from Ameren-UE contractor, maximums for VOCs detected at 1-2 feet, arsenic at 0-2 feet.

ASL = MO. DHSS Any-Use Soil Level

EMEG = ATSDR's Environmental Media Evaluation Guide

< = less than

N/A = Not Available

Although not expected to be a FMGP contaminant, tests for polychlorinated biphenyls (PCBs) were conducted on a shallow soil sample (10-12 inches deep) taken near an electrical transformer storage area. PCBs were not detected (1).

## On-Site Groundwater Sampling

On-site groundwater was sampled for PAHs and metals during the SI/RSE from monitoring wells placed on site. The one-time sampling results of the four on-site monitoring wells indicated no elevated levels of contaminants. Still, the laboratory detection limit (less than 0.3 parts per million (ppm)) for benzo(a)pyrene was slightly above its EPA Maximum Contaminant Level (MCL) of 0.2 ppm in two of the samples (1).

## Off-Site Contamination

As part of the February 2000 sampling, a single off-site soil sample (3-4 inches deep) was taken in a residential yard across Franklin street from the FMGP. This residence is the nearest to the site and approximately 75 feet southwest from the site's southern boundary. Analysis of the sample showed that only benzo(a)pyrene was present at a level above the ASL (1.9 ppm vs 0.68 ppm). Analysis for PCBs was also conducted, but no PCBs were detected. Because an FMGP contaminant was detected in a residential sample, MDNR recommended follow-up sampling of the neighborhood (1).

In the follow-up sampling on July 2, 2001, MDNR collected six surface soil grab samples (0-3 inches deep) from residences closest to the site where permission could be obtained. Soil samples were again split with a representative from Ameren-UE. The only contaminant detected above the ASL screening value in residential yards was benzo(a)pyrene. One of the samples, together with a duplicate, was taken in the previously sampled yard (1.9 ppm of benzo(a)pyrene) and contained benzo(a)pyrene at 0.83 ppm and 0.59 ppm respectively. A background sample taken from a nearby park contained 0.14 ppm of benzo(a)pyrene. The other three residential samples found benzo(a)pyrene present at 0.73 ppm, 0.88 ppm, and <0.5 ppm (2).

## DISCUSSION

Analytical results for off-site soils, on-site shallow soils, and on-site subsurface soils were compared to Missouri's DHSS Any-Use Soil Levels (ASL) and ATSDR's Environmental Media Evaluation Guides (EMEGs). An ASL is a health-based value representing the maximum concentration of a chemical that will always be acceptable in soil regardless of future land use. EMEGs are guidelines used to determine whether there is a need to further investigate exposure to chemicals for their possible health effects. Levels below the EMEG are unlikely to pose a health threat. These values are used as screening values. And because a number of the detected contaminants exceed their screening values, they will be further evaluated in this section. Nevertheless, exposure to a contaminant above its screening value does not mean that a health effect will occur. It does mean that the exposure route to that chemical needs to be further evaluated to determine if there is the potential for health effects. For a number of the chemicals, EMEGs were not available to use as a screening value. Thus ASLs will be used as the screening standard to determine if further evaluation is

needed.

The Moberly FMGP site has been found to be contaminated with coal tars containing benzo(a)pyrene and other PAHs at elevated levels in shallow soils, with higher levels in sub-surface soils on site. On the site, benzo(a)pyrene was detected at a maximum of 1,200 parts per million (ppm) in shallow soils (4-6 inches) and up to 3,000 ppm in subsurface soils (1-2 feet). Benzo(a)pyrene is considered the most harmful and toxic (classified as a probable human carcinogen) in the PAH group of chemicals and will be the focus of this health consultation. Benzene (carcinogenic), toluene, and total xylenes (all VOCs), were detected above DHSS's ASL in a few samples in subsurface soils on site (1).

Potential exposure pathways on and off site consist of dermal contact, incidental ingestion, and inhalation of PAH and VOC chemicals. On site there is the potential for exposure, but normal activities by the workers are not expected to disturb the contaminated shallow soils. There is the potential for exposure if the contaminated shallow soils or subsurface soils are disturbed. Once the heavily contaminated soils are disturbed, such as during remediation, workers could be exposed to the carcinogens benzo(a)pyrene and benzene, as well as other PAHs and VOCs at levels that could cause adverse health effects. Also, if proper precautions are not taken, contaminants could leave the site and potentially expose the surrounding community.

PAH chemicals are formed during the incomplete combustion of coal, oil, gas, wood, and garbage and make up a family of more than 100 chemicals. They can be found in substances such as crude oil, coal tar, tar pitch, creosote, and roofing tar. Domestic sources that contain PAHs include cigarette smoke and wood smoke, as well as charbroiled and smoked meats. PAHs are found throughout the environment in the air, water, and soil. PAHs bond tightly to soil and dust particles and do not easily dissolve in water. They are present in air as vapors or attached to the surface of small particles. Many plants, including vegetables and fruits, can take up and store certain PAHs, although plant uptake is generally low. This does allow for the edible parts of plants grown in PAH-contaminated soil to contain higher concentrations than are found in the soil in which they are grown. Of most concern are root crops and low growing crops that are directly exposed to the contaminated soil and may not get washed completely before consumption (4).

Of the VOCs detected on site, benzene presents the greatest health concern. The Department of Health and Human Services (DHHS) and EPA have determined that benzene is a known human carcinogen. Industrial processes are the main source of benzene, but it occurs naturally in volcanoes, forest fires, crude oil, gasoline, and cigarette smoke. Benzene breaks down slowly in water and soil and can pass into the air from water and soil. Brief exposures (5-10 minutes) to certain levels of benzene (700-3,000 ppm) can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. People who have long-term exposure to relatively high levels of benzene in the air can experience harmful effects in the tissues that form blood cells, especially the bone marrow. This condition is called acute myeloid leukemia (5). Presently the benzene-containing materials are not expected to be a health concern unless they are disturbed, as during the remediation, and the benzene is allowed to volatilize into the ambient air.

Soils in the residential area off site have been found to be contaminated with a single PAH chemical (benzo(a)pyrene) above its ASL. Levels detected in surface soils (0-3 inches) in residential soils ranged from a background of 0.14 ppm to a maximum of 1.9 ppm. Of these, a few are slightly above the ASL of 0.68 ppm, but no completed exposure pathway seems to exist—except at the residence where the highest level of benzo(a)pyrene (1.9 ppm) was detected. Follow-up sampling in this yard, a few feet farther from the site, detected benzo(a)pyrene at 0.83 ppm and 0.59 ppm (2).

Presently there is only one known exposure route to levels of benzo(a)pyrene above the ASL: intermittent exposure off site is expected to be occurring from a child's or children's activities of playing with toys in benzo(a)pyrene-contaminated soil located near where the maximum level of contamination (1.9 ppm) was found. The level of benzo(a)pyrene was not determined for the soil actually being played with on the sidewalk. But considering a worse-case event, the child could be playing in soil containing that level of contamination on a part-time basis during the summer months. Evidence of children playing in the contaminated soil indicates exposure has occurred in the past, is presently occurring, and is expected to

continue to occur in the future unless actions are taken to eliminate the exposure.

To determine if health effects might be occurring from this exposure, DHSS researched available chemical exposure databases. Studies on animals have been done for intermediate exposures (15-364 days) to benzo(a)pyrene and other PAHs for non-cancer effects. Studies of intermediate exposures to animals show that the No Observed Adverse Effect Levels (NOAELs) for PAHs are at doses many times higher than residents would be expected to be exposed to. A NOAEL is a chemical-specific dose, at which no adverse health effects were observed in the study subjects (4). Because the expected dose from incidental ingestion of surface soils is well below the NOAEL, non-cancer adverse health effects from exposures to PAHs in surface soils in residential areas near the Moberly FMGP would not be anticipated.

Benzo(a)pyrene and other PAHs have been shown to cause cancer in animals and are believed to cause cancer in humans. While PAHs have been shown to cause cancer in animals, the majority of the data is from high level parental exposure and this route is not applicable to what humans may expect to encounter. Parental exposure is exposure other than through the digestive system, such as injection beneath the skin, within the muscle, within the sternum or into a vein (4). Because exposure is occurring intermittently and to low levels (slightly above the ASL) of PAH contaminated soils, we do not expect any adverse health effects to occur.

### **Children and Sensitive Populations**

A sensitive population will exhibit a different or enhanced response to hazardous chemicals than will most persons exposed to the same level of hazardous chemicals in the environment. Reasons might include genetic makeup, age, health and nutritional status, and exposure to other toxic substances. In general, the elderly, with declining organ function, and the young, with immature and developing organs, are more vulnerable to toxic substances than are healthy adults (4).

Because children often play in the dirt and engage in a large amount of hand-to-mouth activity, ingestion of contaminated soils at the site could be a more important source of PAH exposure to children than to adults. Children in the residential area are expected to only have intermittent exposure to low levels (slightly above the ASL) and are not expected to have adverse health effects from that exposure. Exposure can almost be completely eliminated if good personal hygiene practices are observed. Children exposed to the high level of PAH contamination on site would be a health concern, but that level of exposure is not expected to occur.

If exposure to benzene occurs, it is expected to be to workers during the remediation of the site. If benzene vapors escape from the site, and children are exposed, they would be more likely than adults to experience adverse health effects (5).

## **CONCLUSIONS**

Based on available data and the fact that exposure could have occurred in the past, is presently occurring, and has the potential to occur in the future (but not at levels expected to cause adverse health effects) the Moberly FMGP has been classified as No Apparent Public Health Hazard. The category of No Apparent Public Health Hazard is used for sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard. This classification is based on the following conclusions:

1. Low-level exposure to benzo(a)pyrene could be occurring on an intermittent basis at a single residence in the community, but the exposure is not likely to cause adverse health effects.
2. On-site soils at depth are highly contaminated with various PAHs and VOCs that could potentially lead

to exposure both on and off site during remediation.

3. Exposure could potentially occur to remediation workers if proper protective measures are not taken.

## **RECOMMENDATIONS**

1. Take precautions to protect the public and workers from potential exposure to on-site chemicals during site remediation.

## **PUBLIC HEALTH ACTION PLAN**

The Public Health Action Plan (PHAP) for the Moberly FMGP contains a description of actions to be taken by the Missouri Department of Health and Senior Services (DHSS), the Agency for Toxic Substances and Disease Registry (ATSDR) and others. The purpose of the PHAP is to ensure that this health consultation not only identifies public health hazards, but provides an action plan to mitigate and prevent adverse human health effects resulting from past, present, and future exposures to hazardous substances at or near the site. Included is a commitment from DHSS or ATSDR or both to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by DHSS, ATSDR, and their cooperators are as follows:

1. DHSS/ATSDR will provide health education (e.g., information about hand washing) so citizens will be better able to prevent exposure. DHSS will provide health education through written materials and one-on-one conversations at an MDNR-sponsored meeting to inform residents and interested participants about the site and anticipated remedial actions.
2. DHSS/ATSDR will coordinate with environmental agencies to address community health concerns as they arise.
3. DHSS/ATSDR will evaluate any further data that becomes available about human exposure or contaminants at the site.
4. MDNR, through their cooperative program, will review the remediation plan for the site and ensure through monitoring and verification that the remediation is protective to residents and workers.

## **PREPARERS OF REPORT**

Arthur Busch, Gale Carlson, Missouri Department of Health and Senior Services.

## **REFERENCES**

1. Missouri Department of Natural Resources. Integrated site inspection/removal site evaluation report. Moberly FMGP Site, Randolph County, Missouri. 2000 September 22.

2. Missouri Department of Natural Resources. Site reassessment, Moberly FMGP Site, Moberly, Missouri. 2001 July 2.
3. Missouri Department of Natural Resources, Cleanup levels for Missouri (CALM) Document. 2001 September 1.
4. Agency for Toxic Substances and Disease Registry. Toxicological profile for polycyclic aromatic hydrocarbons (PAHS), update. Atlanta: US Department of Health and Human Services; 1995 August.
5. Agency for Toxic Substances and Disease Registry. Toxicological profile for benzene, update. Atlanta: US Department of Health and Human Services; 1997 September.

## **CERTIFICATION**

This Moberly Former Manufactured Gas Plant (FMGP) Site Health Consultation was prepared by the Missouri Department of Health and Senior Services under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated.

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The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

Richard Gillig  
Section Chief, SPS, SSAB, DHAC, ATSDR



[Figure 1. Site Location Map](#)

**Figure 1**  
Site Location Map

**Moberly Former Manufactured Gas Plant  
Moberly, Missouri**

